

Neutrophil, the most abundant class of white blood cell in the human body, is responsible for detecting, intercepting, and destroying invading bacteria in inflamed or injured tissue. These cells are known to be highly sensitive and robust to chemical stimulus, although the precise mechanisms for bacterial detection and subsequent motion to the target is largely unknown. In this report we will focus on one candidate mechanism for signal detection and signal sensitivity enhancement: cell morphology. Specifically, we examine how local deformations of the neutrophil cell membrane can improve the cell's ability to sense its environment. After a review of the relevant biology, we present our calculation on the optimal shape a cell should take to sense and amplify a directed signal and show how this relates to current experimental work in immunology. Additionally, we show what gradient are difficult for the cell to sense, regardless of shape. Next, we present a dynamic model of neutrophil morphology; the point of the model is to elucidate mechanisms for how the cell can obtain or approximate the optimal shape that we previously calculated. Lastly we discuss our work on lipid raft segregation and how this could be an effect of cell shape dynamics.